Transit Strategies

Light Rail Transit (LRT)

Light rail transit (LRT) is electrified rail service that operates in urban environments in completely exclusive rights-of-way, in exclusive lanes on roadways, and in some cases in mixed traffic. Most often, it uses one to three car trains and serves high volume corridors at higher speeds than local bus and streetcar service. Design and operational elements of LRT include level boarding, off-board fare payment, and traffic signal priority. Stations are typically spaced farther apart than those of local transit services and are usually situated where there are higher population and employment densities.

MAX Light Rail (Portland, OR)

The T Light Rail (Pittsburgh, PA)

Characteristics of LRT Service

LRT is popular with passengers for a number of reasons, the most important of which are that service is fast, frequent, direct, and operates from early morning to late night. These attributes make service more convenient—much more convenient than regular bus service—and more competitive with travel by automobile. Characteristics of LRT service include:

- **Frequent service, typically every 10 minutes or better**
- **Long spans of service, often 18 hours a day or more**
- **Direct service along major corridors**
- **Fast service**

Keys reasons that service is fast are the use of exclusive rights-of-way—exclusive lanes in the medians of roadways, in former rail rights-of-way, and in subways—and that stations are spaced further apart than with bus service, typically every half mile (although stations are often spaced more closely within downtown areas).

Differences between LRT and Streetcar

Light rail and streetcar service are often confused, largely because they share many similarities. The major similarities include the basic rail infrastructure, and for modern streetcar services, the vehicles. Major differences include:

- Light rail typically operates in exclusive lanes or an exclusive right-of-way while streetcar service operates in mixed-traffic.
- Light rail lines are longer (typically up to 15 miles, but sometimes longer) while streetcar lines are shorter (typically 2 to 3 miles).
- Light rail stations are spaced farther apart than streetcar stations.
- Light rail lines are designed to serve higher volumes of passengers and typically operate with two to three car trains while streetcar service operates with single car trains.
- Because light rail lines serve higher volumes of passengers, stations are larger and usually more elaborate.

Many modern light rail systems still retain many streetcar characteristics in some areas. For example, in Boston, Pittsburgh, and San Francisco, light rail operates in tunnels in downtown but in mixed-traffic in some outer areas.

Service Element	Light Rail	Streetcar
Vehicles	Modern light rail vehicle	Modern or historic streetcar
Train Length	Two to three cars	One car
Line Length	Longer (12-15 miles)	Shorter (2-3 miles)
Running Way	Dedicated right-of-way	Mixed-traffic
Fare Collection	On station platform	On station platform or on vehicle
Stations	Long platforms; significant facilities	Short platforms; modest facilities
Station Spacing	½ to 1 mile	2 to 3 blocks
Speed	Faster (up to 65 mph)	Slower (up to 45 mph)
Development Benefits	Around stations	Along line
Construction Impacts	Major	Minor to moderate

LRT Benefits

LRT has become increasingly popular in the United States due to the benefits it provides:

- **Service Quality:** LRT is typically faster, more convenient, more comfortable, and more attractive than bus service.
- **Higher Ridership:** LRT can significantly increase ridership because it is more attractive.

- **Development:** LRT has a demonstrated effect on generating transit-oriented retail and housing development.

LRT Challenges

Light rail transit also has significant challenges, most notably related to its cost and appropriateness:

- **Implementation Cost:** Because LRT requires a dedicated track and new infrastructure, developing a light rail system is much more expensive than increasing service in a typical bus network. Building an LRT system can cost upwards of $100 million per mile.
- **Required Density:** LRT only becomes a cost-effective option when ridership numbers are high. This is because the savings in per capita operating costs offset the initial financial cost of building the system. Most cities that have successfully implemented light rail have a density of at least 30 residents per acre or at least 15 jobs per acre. If the city does not have the density to support light rail, the light rail alignment must be very carefully designed to have stations in the densest areas of the city.
- **Right-of-Way Availability:** The development of LRT requires an exclusive right-of-way or exclusive light rail lanes on arterial streets, which often requires converting lanes from automobile to transit use. The availability of suitable right-of-way is often one of the major challenges in developing LRT.

LRT Elements

LRT offers high-quality service that provides some of the flexibility of bus systems with many of the attractive features of rail systems. The level of quality is dependent on physical elements including:

- **Special Vehicles** that provide greater comfort, run on electricity (with overhead catenary wires and poles), have a greater carrying capacity, and can reach higher speeds (65 mph) than regular buses.
- **Exclusive Running Ways** that can be either dedicated right-of-way on existing roads or a grade-separated, off-street right-of-way. Depending on the topographic conditions of the corridor, a light rail system can be engineered to run through tunnels, above ground, and at street level to best optimize route performance.
- **Transit Signal Priority** for on-street light rail systems reduces the likelihood of automobile/LRT collisions and supports on-time performance by reducing average signal wait time.
- **LRT Stations** that provide similar features, amenities, and levels of passenger comfort as heavy rail stations.
- **Level Boarding** through the use of high-platform stations to reduce dwell times and facilitate boardings and alightings by people with disabilities.
- **Pre-Paid Fare Collection** via either pre-paid passes or the sale of tickets from ticket vending machines at stations and stops eliminates delays associated with on-board fare collection.

- **Real Time Passenger Information** to inform passengers when the light rail vehicle will actually arrive or depart from stations, which reduces much of the uncertainty that is associated with transit service.
- **Effective Connections** with other transit and surrounding areas.

These measures work together to make service fast and reliable, to make it convenient and comfortable, and to establish a strong customer demand for service.

LRT Vehicles

LRT vehicles are electric vehicles that operate on metal rails that either were previously used as a railroad line or were installed specifically for the light rail. They are somewhat larger than streetcars (80 to 90 feet long, carrying 150 to 220 people per car), and are often coupled together to form trains that carry more passengers than a single car. Light rail vehicles can be faster over long distances than streetcar vehicles (with top speeds around 65 miles per hour, compared to about 45 miles per hour), although streetcars can accelerate more quickly. The greater speed and capacity of LRT vehicles make them an attractive choice for longer routes or regional intercity services.

Green Line (Minneapolis, MN)

Phoenix Valley Metro Light RAIL (Phoenix, AZ)

Light Rail Running Ways

LRT typically operates in exclusive rights-of-way, which include:

- **Grade Separated Rights-of-Way** in which LRT service operates in a completely exclusive right-of-way, often in a former rail right-of-way. Examples include the Central Link section of Link Light Rail in south Seattle and Tukwila, WA, which uses parts of an old rail line to travel quickly between cities, and the Green Line of the MAX Light Rail system in Portland, which uses grade separation to avoid a major freeway interchange. Many other light rail lines, such as Boston's Green Line, Pittsburgh's The T, and San Francisco's Muni Metro operate in tunnels in the urban core.

Seattle Light Rail in Elevated Section

Boston Light Rail in Tunnel

- **Exclusive Lanes on Arterial Streets,** which can be in either the center of streets or in curb lanes. Where exclusive light rail lanes are provided, center lanes are the most common approach. Exclusive lanes can be separated from general traffic by physical elements, such as curbs, or by striping. Physical separation helps to decrease the potential for light rail/automobile collisions.

Phoenix Light Rail in Center Median

Minneapolis Light Rail in Side Lanes

Transit Signal Priority

Signal priority modifies normal traffic signal operation to facilitate the movement of transit vehicles by changing the signal to green early or by extending the green signal until the light rail passes through. This significantly reduces signal delays and can reduce travel times by 5% to more than 20%. Signal priority is typically implemented in conjunction with on-street light rail lanes.

LRT Stations

LRT systems usually have substantial stations. They typically have partial shelters, ticket-vending machines, schedule information, and platforms that are level with vehicle height to ensure accessibility.

Phoenix Light Rail Station

San Jose Light Rail Station

Level Boarding in Dallas

Level Boarding in San Francisco

Level Boarding

Most modern LRT systems are designed to support level boardings. This is typically accomplished by using high- platform stations. Level boarding allows passengers to board and alight faster, which greatly reduces dwell times. Level boarding also makes it much easier for people with disabilities to board and alight and eliminates the need to use lifts.

Fare Collection

Off-board fare collection can significantly reduce dwell times at stations by eliminating the time involved for passengers to pay fares as they board vehicles. Ticket vending machines at stations allow passengers to purchase a ticket before boarding the light rail.

Real-Time Passenger Information

Real-time passenger information at stations lets riders know when the light rail will actually arrive or depart from stations, which reduces some of the uncertainty that is often associated with transit service.

Ticket Vending Machines in Los Angeles

Real-Time Information (Minneapolis)

Effective Connections

Effective LRT services should be well connected to other transit services and the surrounding environment. Major LRT lines become a transit system's backbone with connections to other routes. In most cases, with the implementation of light rail, existing local bus routes are either discontinued or converted to feeder routes.

Like all transit services, the large majority of passengers access LRT lines by walking; therefore, effective pedestrian connections between LRT lines and the areas they serve are critical. It is important to provide signalized intersections near light rail stops to discourage jaywalking across arterials and light-rail tracks.

Bicycles can be an effective piece of a multimodal commute, and it is important that light rail vehicles accommodate bicycles. This is typically done by providing bike hooks for vertical bike storage in each light rail car. Light rail stations are also good locations for bike lockers and bike share programs.

Bikes on LRT (Santa Clara Valley, CA)

Bike Share at LRT Station (Phoenix, AZ)

LRT in the United States

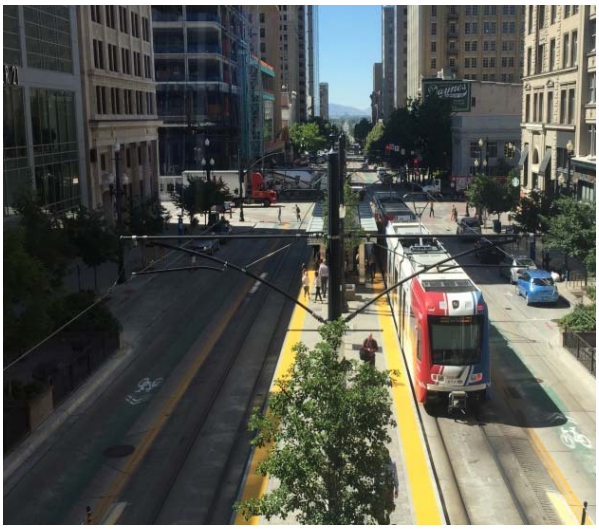
The United States has more than 30 light rail systems, primarily in mid-sized to large cities. Several successful light rail lines are highlighted below.

Salt Lake City, UT

Transit Express or TRAX, operated by the Utah Transit Authority (UTA), is the three-line light rail system that serves Salt Lake City and many of its suburbs.

The first line, the Blue Line, opened in 1999 and has been extended twice, in 2008 and 2013, to 19 miles and 24 stations. The second line, the Green Line, opened in 2001 and has also been extended twice, in 2003 and 2011, to 24 miles and 25 stations. The Green Line connects the University of Utah Medical Center with Daybreak (South Jordan). The most recent line, the Red Line, opened in 2011 and was extended in 2013 to 15 miles and 18 stations. The Red Line connects Salt Lake City International Airport with West Valley City. The system now totals 58 miles and serves 50 stations and 65,000 passengers per weekday.

Center UTA Station

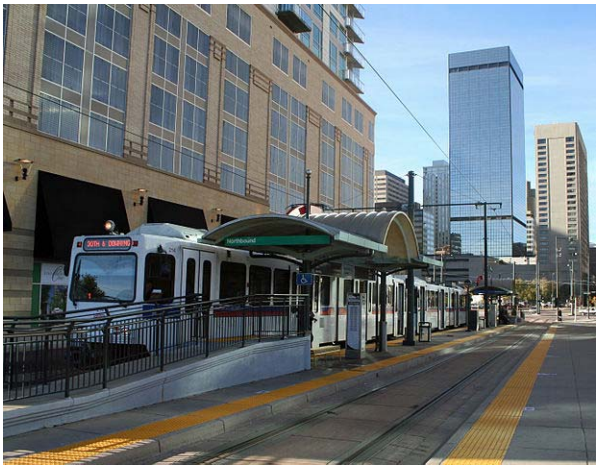


TRAX Blue Line

Denver, CO

The Denver RTD has undertaken the most aggressive light rail development in the United States. The first line opened in 1994, and since then, six more lines have been developed.

Denver Light Rail



Denver Light Rail Vehicle

These lines total 59 miles long and serve 54 stations spaced slightly over one mile apart. The seven lines carry approximately 67,000 passengers per weekday.

CHARLOTTE, NC

Charlotte's LYNX is a 19.3-mile light rail system that serves 26 stations (seven of which include park-and-ride facilities). The line carries approximately 24,000 passengers per weekday.

Charlotte Lynx Light Rail

Charlotte Light Rail Vehicle

Since its opening in 2007, and its expansion in 2018, Lynx has spurred over eight million square feet in residential and commercial development, nearly 100,000 new jobs, and over $1 billion in private investment. While much of this development has been driven by the private sector, the City of Charlotte has also taken measures to ensure an effective mix of uses around stations and along the corridor. These include an Affordable Housing Trust Fund that provides public funding to private developers in exchange for affordable units through a competitive bid process; the city's 2020 Vision Plan that encourages high-density development along major transportation corridors; and the revision of zoning laws to align with transit investment and reduce the burden that developers face with time-intensive rezoning processes.

Minneapolis, MN

Metro Transit operates the Minneapolis/St. Paul area light rail system, which currently consists of two lines with more planned. The Blue Line is 12 miles long, with 19 stations extending from

Minneapolis Blue Line Light Rail

Minneapolis Light Rail Vehicles

downtown Minneapolis to Target Field, Mall of America, and Minneapolis-St. Paul International Airport. The Blue Line opened in June 2004 and currently averages 28,000 weekday passengers. The Green Line is an 11 mile long, 23 station line that connects downtown Minneapolis, University of Minnesota, and downtown St. Paul. The Green Line carries over 35,000 passengers per weekday.

A planned expansion of the Green Line (formerly called the Central Corridor) is slated to be completed in 2020 and will run southwest from downtown Minneapolis to three large suburbs of the Twin Cities: St. Louis Park, Hopkins, and Eden Prairie. An extension of the Blue Line (formerly called the Hiawatha Line) is planned to run northwest of downtown Minneapolis through Golden Valley, Robbinsdale, New Hope, Crystal, Brooklyn Park, and Osseo.

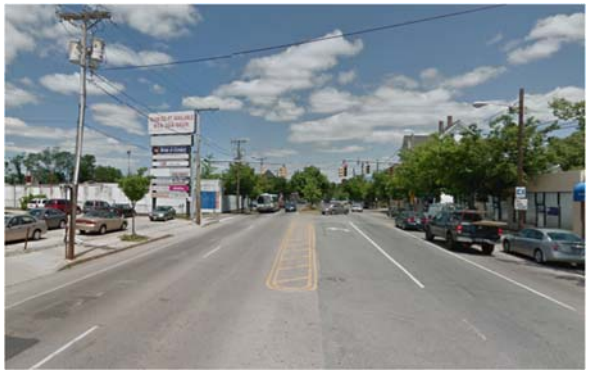
Potential LRT Service in Rhode Island

Light rail is cost-effective when it carries very high volumes of passengers. In Rhode Island, the corridors that would be best suited for light rail – in terms of demand – would be:

- The current R-Line corridor from Downtown Pawtucket to the Cranston City Line via Main Street, downtown Providence, and Broad Street. There is also likely sufficient demand to the north to Central Falls and to the south to TF Green Airport.
- Between Olneyville Square and College Hill via downtown Providence.

However, one major challenge would be to fit light rail into existing rights-of-way. In many areas, existing roadways have only two travel lanes plus parking lanes. In the R-Line corridor,

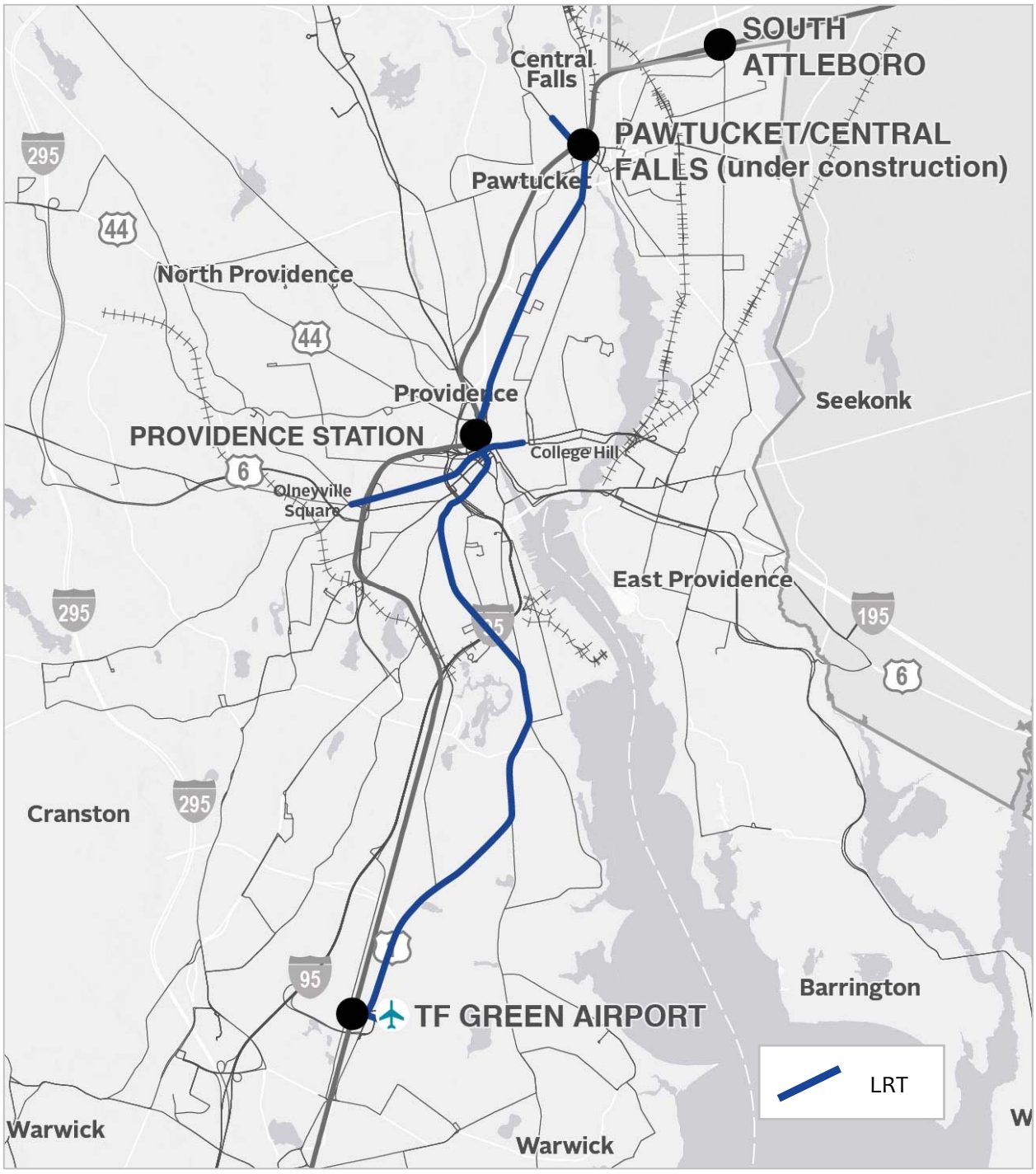
North Main Street, Providence



Main Street, Pawtucket

Broadway, Providence

Broad Street, Providence

this would be the case along most of the length of the two potential corridors. This does not mean that light rail would not be feasible, but that compromises would need to be made, including the elimination of on-street parking. It is also likely that some property taking would be required in station areas.

Potential LRT Lines (Conceptual; Actual Alignments Could Vary)